Shin WATANABE*: **A fusiform green alga, *Monoraphidium braunii* and its new variety (Chlorococcales)**

渡辺 信*: 緑藻クロロコックム目 *Monoraphidium braunii* とその1新変種

In the course of a taxonomic study on algae from Japanese soils, four green algae were isolated by the method reported previously (Watanabe, 1977). They share characteristics identical with those of *Monoraphidium braunii* (Oocystaceae, Chlorococcales). Since one of four isolates, however, possesses some different characters from those typical of *M. braunii*, it is considered to be a new variety of the species. The present paper deals with the description of *M. braunii* and its new variety together with some discussions of the taxonomic status of the species.

A culture of newly described organism has been deposited in the Culture Collection of Algae, Institute of Applied Microbiology, University of Tokyo.

I wish to express my sincere gratitude to Prof. Harold C. Bold, The University of Texas, to Prof. Mitsuo Chihara, The University of Tsukuba, and to Prof. Masaru Akiyama, Shimane University, for their criticisms of the manuscript. Thanks are also due to Prof. Atsushi Takimoto, Kyoto University, for the correction of the English, and to Assoc. Prof. Kazumasa Yokoyama, Shiga University, for his kind help in preparation of the Latin description.

Monoraphidium braunii (Nägeli in Kützing) Komárková-Legnerová var. **braunii**, in Stud. in Phycol. p. 100, pl. 13, 14, 1969. (Fig. 1)

Synoym: *Ourococcus multisporus* Bischoff et Bold in Phycol. Stud. IV, p. 42, figs. 68, 69, 127–130, 1963.

In actively growing cultures cells fusiform, straight or nearly straight, gradually attenuated at both ends. Ends usually sharp but sometimes round in adult cells. Hyaline spiny projections lacking. Cells 2–5×10–29 μm in size. Cells becoming polymorphic upon aging, ellipsoidal, subspherical, ovoid,

---

* Laboratory of Applied Botany, Faculty of Agriculture, Kyoto University, Kyoto 606.
〒606 京都大学農学部応用植物学研究室

broadly fusiform. One or two nodule-like or tail-like thickenings present in some old cells. The chloroplast parietal, trough-shaped, occupying more than half of the inner surface of the cell with some incisions at mid-region. The pyrenoid single, spherical, located at the center of cell. Small starch grains loosely arranged around the pyrenoid. The nucleus and nucleolus sometimes visible in mid-region near the cell wall. Vacuoles lacking. Oil droplets present.

Reproduction by forming 2-8 autospores. A mother cell transversely splitting at the center of cell or separating into two conical segments.

Plant mass green and smooth, but the color changing to reddish brown in old cultures.

M. braunii var. *braunii* was isolated from wet sandy soil on the bank of the Yodo River running through Yawata Town, in the southern part of Kyoto Prefecture, where *Solidago altissima* occupied dominantly, and from soil in the campus of Kyoto University.

The examination of the specimen of *Ourococcus multisporus* Bischoff et Bold (1963) deposited in the Texas Culture Collection (No. 1240) showed that this species coincides with *M. braunii* var. *braunii*.

Monoraphidium braunii var. **viridis** S. Watanabe, var. nov. (Fig. 2)

Cellulae 2-5×10-20 μm (raro usque ad 29 μm longae). A typo differt characteribus sequentibus: 1) pyrenoides tecta aliquot granis amyli segmentatis quae continue disposita sunt, 2) membrana matris secus axem longitudinalem rumpit, 3) massa plantarum viridis etiam in cultura vetere.

Origo: Plantae e solo orae thinii in loco Tottori-ken dicto, m. Nov., 1971 lectae: numerus culturae TOT-5.

Typus: Fig. 2.

In actively growing cultures, cells fusiform, straight or slightly curved, gradually attenuated at both ends. Hyaline spiny projections lacking. Cells 2-5×10-20 μm in size (rarely up to 29 μm in length). Cells becoming polymorphic, ordinarily swelling upon aging; and the ends enlarging to a nodule-like or tail-like shape. One end of the cell sometimes attaching to a piece of cover glass deposited in the BBM solution. The chloroplast parietal, trough-shaped, occupying more than half of the inner surface of cell. The pyrenoids, one or sometimes two, spherical, and located at the center of cell. Saucer-shaped starch grains closely arranged around the pyrenoid. The nucleus and nucleolus not visible without staining. Vacuoles sometimes

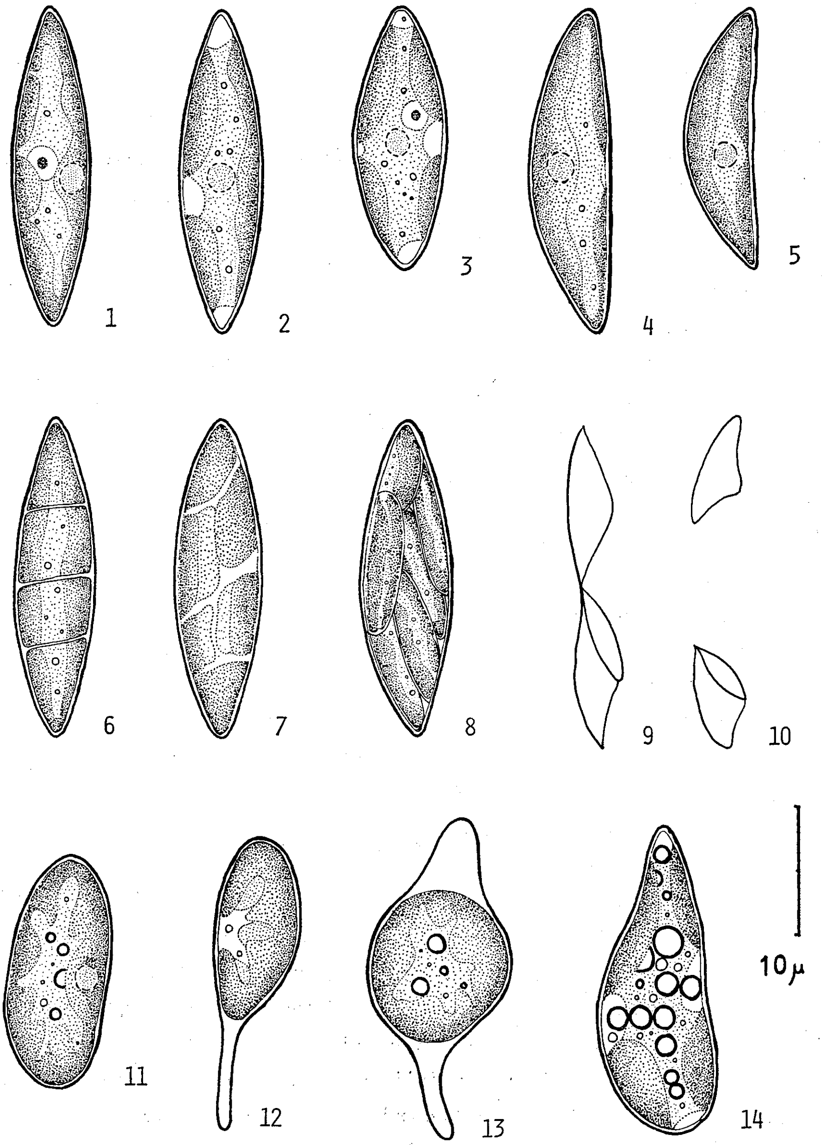

Fig. 1. *Monoraphidium braunii* (Nägeli in Kützing) Komárková-Legnerová var. *braunii*. 1–5, straight or slightly curved fusiform cells in actively growing cultures. 6–8, formation of autospores. 6 and 7, cells with divided chloroplasts. 8, a sporangium containing autospores. 9, an empty mother cell wall splitting transversely at the mid-region of cell. 10, empty mother cell walls separated into 2 fragments. 11–14, cells showing various forms in old cultures.

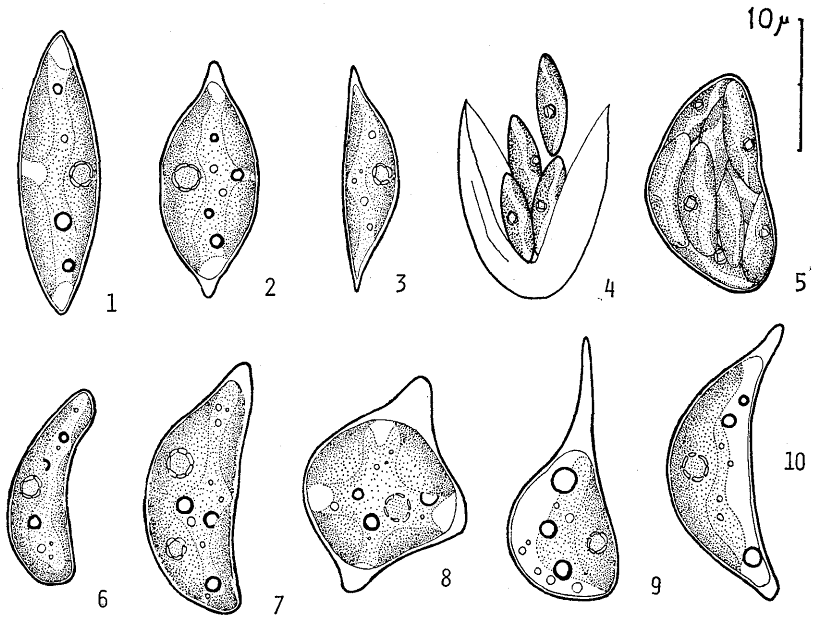

Fig. 2. *Monoraphidium braunii* var. *viridis* S. Watanabe var. nov.
1-3, fusiform cells in actively growing cultures. 4, just liberated autospores and an empty mother cell wall which deeply splits along the longitudinal axis. 5, a sporangium containing autospores in old cultures. 6-10, cells showing various forms in old cultures. 7, a cell with two pyrenoids.

present. Oil droplets accumulated.

Reproduction by forming 8–16 autospores. Autospores fusiform and almost equal in a sporangium. A mother cell splitting along the longitudinal axis.

Plant mass green and smooth, and the color not changing in old culture.

Var. *viridis* was isolated from soil of the coastal sand dune in the garden of Sand Dune Research Institute of Tottori University, where *Pinus thunbergii* was growing.

Var. *viridis* resembles var. *braunii* in shape and size of cells and both show polymorphism in old cultures. However, they differ from each other in the following attributes: 1) the starch grains around the pyrenoid in the former are larger and more closely arranged than those in the latter, 2) the mother cell of the former bursts open along the longitudinal axis but that of the latter transversely, and 3) the color of plant mass does not change upon aging in the former but it changes in the latter.

Presence or absence of pyrenoid has been evaluated as a generic criterion in the Chlorococcales by Starr (1955), Bold (1970) and other phycologists. Currently in *Monoraphidium*, however, both pyrenoid-possessing and -lacking species are included. Since *Monoraphidium* is separated from pyrenoid-lacking genus *Ankistrodesmus* (Komárková-Legnerová 1969), it is appropriate to characterize the former genus as a pyrenoid-lacking one. If we accept this opinion, the present species *M. braunii* should be excluded from *Monoraphidium*, because of the possession of pyrenoid, and then the genus in which *M. braunii* should be classified comes into question. The following three genera come very near *Monoraphidium* on the basis of having fusiform cells which are in solitary and should be candidate for it; *Closteriopsis* Lemmermann (1899), *Keratococcus* Pascher (1915), and *Chlorolobion* Korschikov (1953). According to the description given by some phycologists, including Belcher & Swale (1962), Hindák (1970), Komárková-Legnerová (1969) ; Korschikov (1953) ; Pascher (1915), and Prescott (1951), the circumscription of these three genera seems unclear, because there are some species which stand at an intermediate position among these three genera. Thus, the taxonomic status of *M. braunii* can not be determined at present, and this problem will be solved by the comparative study of these taxa.

References

Belcher, J. H. & M. F. Swale, 1962. Culture studies on *Ankistrodesmus* and some similar genera. 1. Some less common and new British species. Brit. Phycol. J. **2/3** : 126–132. Bischoff, H. W. & H. C. Bold, 1963. Phycol. Stud. IV. Some soil algae from Enchanted Rock and related algal species. The Univ. Texas Publ. No. 6318, 95 p. Austin. Bold, H. C., 1970. Some aspects of the taxonomy of soil algae. Annals of the New York Academy Sciences. **175** : 601–616. Bourrelly, P., 1966. Les algues d'eau douce, Tome I. Les algues vertes. 511 p. Paris. Fott, B., 1971. Algenkunde 2. Auflage 581 p. Stuttgart. Hindák, F., 1970. A contribution to the systematics of the family Ankistrodesmaceae (Chlorophyceae). Arch. Hydrobiol./Suppl. Algol. Stud. **1** : 7–32. Komárková-Legnerová, J., 1969. The systematics and ontogenesis of the genera *Ankistrodesmus* Corda and *Monoraphidium* gen. nov. in Stud. in Phycol. ed. by Fott : 75–144. Prague. Korschikov, A., 1953. Pro-

tococcineae. Vicnačnik prisnovodnich vodorostej Ukrainskoi RSR. **5**, 437 p. Kiev. Legnerová, J., 1965. The genera *Ankistrodesmus* Corda and *Raphidium* Kützing and their position in the family Ankistrodesmaceae. Preslia, **37**: 1–8. Pascher, A., 1915. Einzellige Chlorophyceangattungen unsicher Stellung. in Süsswasser-Flora Deutschland, Österreichs und der Schweiz. **5**: Jena. Prescott, G. W., 1951. Algae from the western great lakes area. 977 p. Iowa. Starr, R.C., 1955. A comparative study of *Chlorococcum* Meneghini and other spherical, zoospore-producing genera of the Chlorococcales. 111 p. Indiana. Watanabe, S., 1977. The genus *Chlorella* (Chlorococcales) from Japanese soils. Journ. Jap. Bot. **52**: 97–106, 129–136, 169–178.

* * * *

京都府南部の八幡町に流れる淀川の河川敷の湿った土壌と，京都大学構内の土壌から，*Monoraphidium braunii* (緑藻，クロロコックム目，オオキスチス科) が分離された。また鳥取大学砂丘研究所の敷地内にある海岸砂丘から，*M. braunii* に近似する緑藻を得た。ピレノイドをとりまくデンプン粒がより大きく，しかも密に配列されていること，自生胞子の母細胞が細胞の軸に平行に割れること，寒天上で古くなっても藻塊は変色しないこと，などの特徴により，この緑藻は *M. braunii* の新変種 var. **viridis** として記載された。

クロロコックム目ではピレノイドの有無が属を分類する形質の一つに考えられているが，従来 *Monoraphidium* 属にはピレノイドを持つ種も持たない種も含められてきた。*Monoraphidium* 属はピレノイドを持たないと特徴づけるのが適当で，*M. braunii* はこの属から除外すべきと考えられる。しかしながら，*M. braunii* をどの属に含めるかはオオキスチス科の数属の今後の比較研究を待たねばならないと思われるので，本論文では今回分離した藻類を *Monoraphidium* 属の一員として記述した。

□山田宗睦： **花の文化史** pp. 290, 読売新聞社，(昭和52年7月) ¥2500。この本については私ははじめ私の学説が引用されているのにおどろいた。そして著者の意図の，他の人の文化史に比べてひどく高いのに再びおどろいたのである。それは雑誌「グラフィケーション」に毎月連載されたが，数年を経て一冊となって出版された。大体50種ほどの草木，樹木をえらび，それに関係した問題を扱っている。道の思想史，花の文化史，水の精神史を構想した中での一部作として出版されたものであるだけに，植物の語源を扱うについても，深くそのもとにまでつっこみ論じている。私はこの文をよみいろいろと啓発されたが，語源を扱う著書として一つの門をなすものといえよう。

(前川文夫)